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And they save energy happily ever after? Persistence of post-intervention practices in households

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Tiivistelmä - Referat – Abstract
Behavior change can be seen as one cornerstone in transiting to more sustainable energy cultures. Various implemented behavioral intervention experiments have been popular and successful in creating behavioral change during and/or right after the intervention period, however follow-up research examining the persistence of changed behavior has been limited.

The empirical material of this thesis builds on a set of data collected in a European research project ENERGISE. The analysis utilizes the data collected from two Finnish living lab experiments performed in 2018, focusing the examination on the closing interviews conducted by the research team and the participants' self-reported practices in the follow-up survey three months after the intervention. The analysis examines the formation of new practices in relation to their persistence in everyday life. Answers to open questions presented in the follow-up survey are also examined in the analysis, to fuller the representation of events. The sample of the research is not enough to make comprehensive statistical generalizations, instead it gives interesting insight on the durability of the effects of one energy intervention.

The research questions guiding this thesis are: How did household practices change when households participated in an intervention? How persistent are the observed changes in practices post-intervention? What contributes to the persistence of treatment effects?

This examination observed persistence of behavioral change post-intervention. This examination suggests that these encouraging results may be supported by a number of different factors; the broad perspective of energy practices that the intervention designed on practice theory provided and the making of household routines visible to participants to question and experiment with. In addition, the intervention techniques used as making commitments, goal setting, social comparison elements and providing energy feedback, which corroborate with prior intervention follow-up studies that have noted the importance of a carefully thought intervention design with these techniques, to support creating permanent behavioral change. Intervention designs should also include a longer-term evaluation as further study investigating the factors contributing to creating permanent change should be implemented.

Keywords
energy interventions, longer-term effects, practice theory, households, energy

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Ja he säästivät energiaa onnellisina elämänsä loppuun asti? Energiainterventioiden pysyvyys pidemmän aikavälin tarkastelussa kotitalouksien käytänteissä.

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Tiivistelmä - Referat – Abstract
Käyttäytymisen muutosta voidaan pitää yhtenä kulmakivenä kestävämpiin energiakulttuureihin siirtymisessä. Erilaiset käyttäytymisenmuutokseen tähtäävät interventiot ovat olleet suosittuja ja niissä on onnistettu muuttamaan käyttäytymistä interventiokokeilun aikana ja / tai heti sen jälkeen. Jatkotutkimuksia, joissa tarkastellaan muuttuneen käytöksen pysyvyyttä, on toistaiseksi kuitenkin toteutettu vähemmän.

Tämän tutkielman empiirinen data perustuu eurooppalaiseen ENERGISE- tutkimushankkeessa kerättyyn aineistoon. Tämän tutkielman analyysissä hyödynnetään aineistoja, jotka ovat kerätty kahdesta vuonna 2018 Suomessa toteutetusta Living Lab kokeilusta. Tässä tutkielmassa tarkastelu keskittyy intervention päätteeksi tehtyihin haastatteluihin, sekä kolme kuukautta intervention jälkeen tehdyn seurannan tuloksiin. Tässä työssä tarkastellen kuinka uudet käytänteet vakiintuivat kotitalouksissa. Seurantalomakkeesta kerättyjä avoimia vastauksia myös hyödynnetään täydentämään tapahtumien esitystapaa. Tämän tutkimuksen otos ei riitä kattavan tilastollisten yleistyksen tekemiseen, mutta antaa kuvan yhden energiaintervention vaikutusten kestävyydestä. Tutkielmaa ohjaavat tutkimuskysymykset ovat: Kuinka kotitalouksien käytännöt muuttuivat osallistuessaan interventioon? Kuinka pysyviä havaitut muutokset olivat intervention jälkeen? Mitkä tekijät vaikuttavat intervention vaikutusten pysyvyyteen?

Tutkimuksessa havaittiin käyttäytymisen muutoksen pysyvyyttä intervention jälkeen. Positiiviset tulokset voivat perustua useisiin eri tekijöihin; energiakäytäntöjen laajaan näkökulmaan, jonka käytäntöteoriaan perustuva interventiosuunnittelema tarjosi, sekä rutiinien näkyväksi tekemiseen, joka auttoi rutiinien kyseenalaistamista. Lisäksi interventiotekniikat, kuten sitoumusten tekeminen, tavoitteiden asettaminen, sosiaalinen vertailu ja tuki, sekä palautteen saaminen energiankulutuksesta, myötäilevät aiemmin tehtyjen interventiotutkimuksien tuloksia, joissa on nähty viitteitä näiden interventiotekniikoiden olevan yhteydessä pysyvän käyttäytymismuutoksen saavuttamisessa. Interventiokokeiluihin tulisi aina kuuluu pitemmän aikavälin tarkasatelu sillä niitä tekijöitä, jotka vaikuttavat pysyvän käyttäytymisenmuutoksen luomiseen, on tutkittava lisää.

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Sisällys

1 Introduction

It is becoming increasingly difficult to ignore the urgent need to reduce greenhouse gas emissions via an overall reduction of energy consumption in the face of climate change. The last decade has produced several approaches at a broader level, such as governmental policy, international agreements, corporate leaderships, educational programs and technological innovations in attempt to answer the serious need to curb energy consumption. Alongside these broad level approaches, the potential of smaller -scale and lower -cost attempts can also be seen as of equal importance. Influencings individuals to change household energy consumption can be a cost-effective path to achieve significant energy reduction changes. (Osbaldiston & Schott, 2012)

There is a pressing need to find the right paths as the European Union targets a 20 % cut in greenhouse gas emissions by the year 2020 (European Commission, 2018) and a climate neutral Europe is called for by the European Commission by the year 2050 (European Commission, 2018). The objectives in the Paris Agreement 2018 aim at keeping the increase of global temperature to less than 2 degrees. To achieve these targets, success in curbing energy consumption in the European Union is needed (Eurostat, 2018).

Many components of everyday lives are highly energy dependent. Daily routines such as preparing meals, washing clothes, watching TV, showering and heating are standard practices that are responsible for a substantial part of household energy consumption. Households were one of the three most intensive energy users in the European Union areas in 2015, being responsible for more than 25% of European Union's total energy use (Eurostat, 2018). It is thus justified to state that households are in a central position when aiming for an overall reduction in energy consumption and shifts in household's energy related practices hold possibility to make significant impact. (Dietz et. al., 2009)

This thesis examines the longer-term effects of energy interventions implemented in households. Through an in-depth study of a small-scale intervention, this thesis seeks to address an important issue that has so far gained little discussion; interventions that only result in temporary behavioral change do not achieve all they aim for. The behavior of participants during an intervention does not reflect how the new behavior continues once the intervention ends. This in turn is important information for researchers and policymakers in the planning of future interventions.

Researchers from different disciplines have shown interest is behavioral change targeted interventions, building their approaches on the different theories of behavior change. (e.g. De Young, 1993; Sovacool, 2014) Behavior interventions are as a promising approach to influence households and possible to be implemented without expensive upfront investments (Vassileva et al., 2013). Several intervention researches have proven to affect pro-environmental behavioral and lead to reduction of household energy consumption during the intervention. (Abrahamse, Steg, Vlek, Rothengatter, 2005).

However, there is still insufficient data as to how the behavioral changes noted during an intervention persist in a longer-term (DeYoung, 1993, Abrahamse et al., 2005). Despite the vast number of intervention studies made, only a handful of studies have continued to track participants over a longer time to evaluate whether the behavioral changes were temporary or permanent. (Wemyss et al., 2019) The research to date has tended to focus on evaluating the results of a program while it is still ongoing, or immediately after the program ends. This does not give a complete view of achieved results and may lead to incorrect conclusions about the effectiveness of the intervention program (Burns & Savan, 2018).

Steg and Vlek (2009) point-out follow-up studies to be generally costly and time-consuming, which are factors explaining the lack of wider follow-up research. Furthermore, describing and/or quantifying the durability of interventions is a methodologically difficult matter as the issues of behavioral persistence are always complex (Burns & Savan, 2018).

This thesis is organized in the following way. Chapter 2 begins by laying out the theoretical background for the thesis. The chapter presents related previous research on pro-environmental behavior and studies on longer-term impacts post-intervention. The research objectives and research questions of the thesis are also introduced in chapter two. Chapter 3 presents the research material and research methods. The chapter begins by an overview of the European ENERGISE research initiative and then provides a description of the intervention design and living lab concept implementation in Finland. Chapter 4 describes the results of the parts of the ENERGISE intervention challenges that are included in this work. Chapter 5 discusses the results of the analysis. The conclusions of this thesis is provided in chapter 6.

2 Theoretical background and prior research

This chapter examines how pro-environmental behavioral change and its durability has been traditionally explained by models and theories of behavior. A considerable amount of literature has been published on pro-environmental behavior and behavioral change arising from such disciplines as economics, psychology and sociology. These frameworks have a strong emphasis on the individual actor as the center of focus, and the theories based on individual behavior have been dominant in energy consumption research. Although having provided useful guidance in planning behavior change interventions, prior studies have however shown to give a quite narrow view of the needed social change to create permanent behavioral change (Hargreaves, 2011). In contrast to the traditional dominant approaches, I also introduce the approach of social practices in my thesis, which takes a different perspective and more contextualized perspective on energy use in households.

The second part of this chapter continues by outlining prior research work done on the longer-term effects of energy interventions and introduces studies that have implemented a follow-up. I will also define the concepts used in this work.

2.1.1 **Encouraging pro-environmental behavior**

Pro-environmental behavior is defined here following Stern (2000) as “those behaviors that change the availability of materials or energy from the environment or alters the structure and dynamics of ecosystems or the biosphere itself, or shapes the context in which choices are made that directly cause environmental change.” p.408.

One of the oldest models created in the early 1970s for pro-environmental behavioral change, an information provision model, assumed people to adapt pro-environmental behavior by getting more environmental knowledge (Kollmuss & Agyeman, 2002). The assumption in this linear model, was the lack of information to be the barrier to carry out pro-environmental behavior. This assumption was soon proven to be too simple and providing more information to the public has not alone resulted to notable shifts toward re-optimized consumption or pro-environmental behavior. (Kollmuss & Agyeman, 2002; Gram-Hanssen 2011; Allcot & Rogers, 2014) Providing consumers with information however still plays a key part in most energy interventions and added information has shown to be an effective treatment as part of a behavioral intervention and being one of the behavioral determinants that has influence on behavior (Allcot & Rogers, 2014).

Several studies approach environmental behavior from a rational actor assumption that people make reasoned choices, for example the significantly influential Ajzen and Fishbein’s (1980) Theory of Reasoned Action and Theory of Planned Behavior. The traditional economic theories of consumer decision-making also lean on a rational actor consumer, consciously choosing the most optimal course of action (Darnton, 2008).

Many behaviors change models after Ajzens and Fishbeins (1980) continued on building strong emphasis on beliefs, attitudes and values of individual’s (Darnton, 2008*)* and also including the broad concept of agency. Agency, in the pro-environmental context refers to the sense that an individual beliefs to carry out actions

to that leads to the wanted outcome. (Ballard & Ballard, 2005) This component has also been raised as significant in the psychological approach to behavior.

Quantitative research has however shown attitude and behavior to have only partial support from each other and when examining factors influencing pro-environmental behavior, a wider view of the numerous conflicting and competing factors that shape actions is needed. The relationship between knowledge and attitudes, attitudes and intentions, and intentions and actual behavior is not straightforward. Especially in longer-term perspective, a disjuncture between knowledge and motivation to act in more sustainable ways has been noted. In the environmental domain, residential energy use has especially been identified as sector in which this attitude behavior gap is particularly evident present (Flynn et al., 2009).

Turning away from these conventional models of individual behavior presented, with consumption often framed as the choice of an individual, the social practice theory offers a more sophisticated understanding to consumption of energy. Shove and Walker (2010) explain social practice theory to examine the doing of everyday practices, with a focus on how practices are maintained, stabilized, challenged and how practices are killed off, as practices only exist as long as there are people repeating them.

In the effort to generate sustainable practices, the social practice theory focuses attention on the social and collective organizations of practices, instead of placing an individual in the center of analyses. Practices are approached as the core unit of analysis in the process or turning the attention away from the decision-making of the individual energy user. (Hargreaves, 2011)

When compared to conventional approaches to influencing energy behavior, social practice theory does not focus on energy use as such. Rather, it is interested in investigating and influencing the social practices, such as practices of keeping clean or practices of thermal comfort, that underlie patterns of energy use. The assumption is that households do not use energy in itself, but as a side effect of engaging in the social practices of everyday life. (Gram-Hansen 2010; Shove & Walker, 2014) Uncovering and analyzing these parts of practices that are not

seen, can be as important as the observable aspects that are often the focus of research. (Shove & Warde 2002)

2.1.2 **Prior studies on longer-term post-intervention effects**

Next, I will present some behavioral energy interventions that have included a longer-term follow-up. This list of prior research is more illustrative than comprehensive, and I have not attempted to form quantitative comparisons between the interventions. Instead, to give an overview of recent studies on longer-term persistence of household energy interventions. There have previously been several attempts to assess the longer-term impact of behavioural interventions (see Table 1).

Throughout this work, the term energy intervention means a program, activity or event that aims to influence behavior. An energy intervention design usually includes a combination of different elements and strategies and energy interventions can be implemented in various settings. (Delmas et al., 2013) Behavioral interventions are aimed to achieve voluntary behavior change and patterns of usage, or they can be aimed to change the context in which decisions are made (Abrahamse et al., 2005).

Table 1. A summary of previous behavioral interventions, the methodology applied, obtained results and the follow up

Intervention strategy & target.	**Methodology and timeframe**	**Results & follow-up.**	**Citation**
Gamified mobile application connected to participant's homes smart meters. Participating cooperatively in a neighborhood energy conservation activity.	12 week intervention Online survey follow-up one year after intervention.	Significant electricity savings immediately after intervention. Follow-up revealed electricity savings not to be long-term. Participants reported improvements in behavior preceding the intervention to exist and the impact of the intervention in their community to likewise persist.	Wemyss, Cellina, Lobisger-Kägi, de Luca and Castri (2019)
A six-module community based multi-technique intervention. Modules targeted different home energy conservation behaviors. To understand barriers and find techniques to overcome them (e.g. commitments, surveys and social events, peer mentoring, prompts and tailored information).	six-month intervention Online survey follow-up seven months after the intervention.	Pro-environmental behavioral changes can be said to have persisted longer-term. No significant decrease in changed behavior was noted in the follow-up compared to program closing.	Burns and Savan (2018)
Two randomized one year-long field experiments that used either normative, or individual feedback messages that were sent weekly to residents. The intervention targeted energy consumption.	16 week intervention. Follow up data collected for 21 weeks after the intervention. Data was collected of electricity consumption and a survey was sent.	Normative elements added to feedback messages did not result in significant energy reduction post-intervention.	Anderson, Song, Lee, Krupka, Lee and Park (2017)

Monthly home mailed reports that featured personalized energy use feedback, social comparisons, and energy conservation information as intervention techniques. The intervention targeted energy conservation.	timeframe of the intervention was 4-5 years Effects were analyzed through monthly billing data of households that were dropped out of the intervention after two years.	The intervention caused an immediate energy conservation effect, but these efforts showed to decline relatively fast. Even the households that had been receiving the reports for two years showed “backsliding” to previous patterns after stopping the intervention.	Allcott and Rogers (2014)
The Visible Energy Trial was implemented in 275 households included three different types of smart meters, through which households were provided a chance to visualize their energy consumption and raise awareness of their consumption patterns. The intervention targeted energy saving.	12 months after the intervention, ended 11 qualitative follow-up interviews were conducted by phone with selected participants.	Follow-up interviews showed eight participants still monitored their energy use, but the monitoring provided only little or no motivation for further energy reduction.	Hargreaves, Nye and Burgess (2013)
Techniques included a combination of information, feedback and social interactions in a group. The intervention was a socially-embedded energy efficiency program that targeted 38 different household behaviors.	The follow-up was conducted two years after intervention end implemented as a set of mail questionnaires.	After the end of the intervention, changes in 46 of the 93 original behaviors assessed were reported. Two years after the intervention, behavior changes in 19 of the 38 behaviors observed were still retained or some even increased. Savings were marked in gas, electricity and water use and in waste production.	Staats, Harland and Wilke (2004)

Next, I will review each study in more detail, and then summarize some of the main findings across studies.

Wemyss et al. (2019) report a recent project in Switzerland which included a longer-term follow up examination. The conducted behavioral intervention included 42 voluntary households, and targeted household electricity saving. The intervention period ran for twelve weeks between February to May 2016, and an online follow up survey that examined the persistence behavioral change, was conducted one-year post-intervention. The behavioral intervention design used a gamified mobile application, “the Social Power App” which connected to participants’ houses smart meters. The app engaged users to participate cooperatively in a neighborhood challenge to complete activities in energy conservation, as well as to realize the achieved progress through visualization of their electricity use. Straight after the three-month intervention, a significant improvement was achieved in electricity savings. The follow up survey conducted one year after the end of the intervention, however showed a relapse of behavior changes and the impacts of the intervention becoming marginal. The noted short-term energy saving impact achieved by the app providing feedback of energy use, does not persist overtime, although the participants of the intervention self-reported their post-intervention behavior to be more conscious. The study so suggested, that the elements to support longer-term positive results, for example motivational elements as challenges as tips, should have been incorporated into the design of the intervention. (Wemyss et. al., 2019).

A post-intervention study from Toronto evaluated a community based multi-technique intervention program named Start Green, which was conducted by Burns and Savan (2017) seven months after the end of the intervention. The intervention took place in two high-rise apartment buildings with about 700 private units, which were occupied mainly by graduate students from the University of Toronto and their families. The intervention design included six different modules that targeted change in different behaviors. The techniques used in their community-based research intervention program, were making public commitments, re-

sponding to surveys and participation in organized Start Green events. The program also trained student representatives to work as peer mentors to encourage occupants of the apartment buildings to pro-environmental behavior. Social events were organized to create community spirit and residents were asked to make commitments to reduce energy consumption. In addition, posters and stickers were used in common areas as prompts, and tailored information with instructions and suggestions related to ongoing module were provided. The participants were also given greenhouse gas reduction kits. The evaluation after a longer-term post-intervention showed promising self-reported persistence of behaviors, and increases in other pro-environmental behaviors. These reported positive post-intervention behaviors are rare and surprising. An online survey with 64 respondents showed no significant changes compared to the program closing and pro-environmental behavioral changes were found to have persisted seven months after ending the program. Burns and Savan (2018) identify the design of the intervention, especially suggesting the social and participatory nature of the program, in having had a key role in success of creating longer-term behavioral change on their experiment. (Burns & Savan, 2018)

Anderson, Song, Lee, Krupka, Lee, and Park (2017) conducted two yearlong feedback-based behavior intervention to reduce energy consumption on a university campus in Seoul, South Korea. Their research paper specifically emphasized the aim to address the knowledge gap of longer-term effects of feedback-based interventions. The two randomized field experiments conducted, examined the durability and effect of normative energy consumption feedback relative to traditional individual feedback. The intervention was implemented in seven student housed buildings, some of which were occupied year-round, while others occupation was set with according to the academic calendar. The research by Anderson et al. (2017) was designed to deliver energy feedbacks, in terms of either a control or treatment message, to the participants weekly for 16 weeks in 2014. Both types of messages included common energy use information on how much energy was consumed during the previous week, as well as energy conservation tips. After the active intervention time, the study continued with a 21-week post-intervention period, which the research defined as a longer-term

follow-up. Using econometric analysis, the authors found longer-term persistence of post-intervention behavioral change to be influenced the durability of normative messaging, especially with the individuals highly influenced by social pressure. Anderson et al. (2017) offers two points to notice when building messaging campaigns in the future, first the time period within messages are sent should be as long as possible. Second, attention should be drawn to convey that a positive norm of energy conservation exists in the individuals. (Anderson et al., 2017)

Allcott and Rogers (2014) reported on the longer-term effects of a widely implemented intervention program in the United States, which was produced by a company named Ompower. The large Ompower reports program included up to 6.2 million households that were sent “home energy reports”, some even up to 60 consecutive months. The techniques of this non-price intervention approach were social comparison, and personalized energy use feedback. The longer-term analysis included inspecting extensive data of monthly billing, from a four to five-year timespan of the participating households. The analysis examined two questions, first the persistence of positive effects when the intervention is not continued, and second, how continuing of the intervention had cause incremental conservation. In addition, the study examined if participants had habituated to these methods after two years. In their examination, Allcot and Rogers (2014) conclude that conservation efforts began to decline relatively quickly post intervention, even when having been part of the intervention the longest rollout timeperiod of two years. The study concluded that even when continuing treatment several years, consumers had not fully habituated to a new practice. Allcot and Rogers (2014) considers these findings through behavioral models suggesting four features for the findings. The reports can work as continually needed cues to change consumption. However, getting accustomed to receiving the reports dismissed the effects caused by the reports and thirdly the study claims the length of the intervention to be a key component for successful longer-term behavioral change, which is also related to change in capital stock or physical technologies. Last, the progress to habituate fully is a time taking process that demands a long continual treatment. (Allcot & Rogers, 2014).

Hargreaves, Nye and Burgess (2013) have also added to the evidence of creating longer-term effects through their study of a feedback-based energy intervention. The study involved placing smart energy monitors in participating households to provide feedback and making energy consumption visible. Interviews conducted at the end of the intervention showed monitoring to have helped participants to learn about their energy use. Interviews conducted 12 months post-intervention showed the energy monitors to still be in use in eight households. However, the monitors had not motivated further energy consumption reduction and rather had become backgrounded within normal household routines. Users also commented to have stopped gaining new information from the energy-monitors in the longer-term follow-up. Although positive results were shown directly after the intervention, the longer-term results of the energy intervention were not shown to persistence. The results suggested that in general, providing information on energy use is too simple of a tool to create permanent reduction of energy consumption in a longer time span. A need for wider policy and market measures and the multiple practices and decision-making processes and logics of different energy user individuals, have to been included in the means, and require a more complex approach. (Hargreaves et al., 2013)

The longer-term effects on electricity savings was also examined in a socially-embedded energy efficiency program in the Netherlands, a study reviewed by Staats et al. (2004) that identified promising longer-term effects. The follow-up was conducted two years after the rollout of The Eco Team Program intervention package. The intervention design included 38 participating households and a threefold intervention strategy. The program included several features; EcoTeam group meetings, providing information through a workbook, and getting feedback by reporting implemented actions. The EcoTeams were groups of 6 to 10 people who participated in meetings to discussed six different themes as agreed in advance. The EcoTeam meetings were held once a month during the intervention, and provided a platform to present achieved results of pro-environmental behavior, update progress as well as focus on the next theme. The information provided by the EcoTeam workbook offered support to the implementation of each theme, by introducing practical ways to execute specific changes. The results achieved, for example a reduction of garbage, was recorded in an Ecoteam logbook, which

then was sent to a central database and used to provide individual feedback to the Ecoteams. The longer-term effects of the in both energy use and the adoption of energy-saving behaviors post-intervention were noticed in the follow-up. Resons that Staats et al. suggested to promote these longer-term findings were the wide range of targeted behaviors and the social support of the organized teams. (Staats et al. 2004)

2.1.3 Summary and further observations on intervention persistence from previous research

Although interventions studies commonly agree on the importance of longer-term durability evaluation, rare cases have continued to track participants post-intervention to evaluate the persistence of change, or other possible effects in a longer-term perspective (e.g. De Young, 1993; Dwyer et al. 1993; Wemyss et al 2018). The studies that have included a comprehensive longer-term follow-up have mostly supported the view, that the positive effects achieved during duration of the intervention, are not fully maintained and have gradually disappeared even after successful intervention. Several of the previous longer-term intervention research studies also reveal, that techniques successful in changing behavior short-term, do not automatically result longer-term impact. (Pallak & Cummings, 1976; Staats et al., 2004)

The most promising longer-term intervention results support the assumption that creating an internal change or a personal norm builds persistent behavior more efficiently than the use of external techniques as incentives (De Young, 1993; Burns & Savan, 2018). The selection of most effective intervention techniques that can be drawn from the previous studies, are providing tailored information, prompts and setting goals, which are behavior antecedent techniques. The most effective consequence techniques identified are using feedback and monitoring. (Anderson et al 2017; Burns & Savan, 2018).

The studies reviewed in the previous section show that especially when combining these techniques with a social element, as peer feedback or making a public commitment, promises of creating persistent behavior have been found. Community based interventions and involving community members in the different stages

of the research progress, have also proven to be significant in creating sustainable behavioral change (Staats et al. 2004; Goodman et al. 2017).

The implemented interventions suggest that strategic use of several techniques simultaneously is the most influence on habits and choices of an individual (Burns & Savan, 2018). Previous studies also indicate that different behavior respond to different treatments, and each technique only works to a certain limit, in addition that it is important to consider personal variables of individuals. (e.g.Havgreas et. al., 2013).

In addition to employing the appropriate techniques, the results of previous research clearly implicate features of the design as timing and persistence, are central in achieving successful longer-term results. (Allcot & Rogers 2014; Burns & Savan 2018). Routine and habituation are important parts of creating persistence of intervention introduced change, which merits an intervention research design which duration is long enough. The techniques that have shown to be most efficient, take time to change behavior, as new habits need time to form. (E.g. De Young 1993; Allcot & Rogers, 2012; Anderson et al. 2017;)

2.1.4 **Research objective**

The objective of this study is to explore the persistence of adopted new practices introduced by energy interventions into households at a practical level in a longer-term view. As presented in the previous chapter, a lack of wider research on the longer-term effects and the persistence of change after discontinuation of intervention exists. On the basis of previous research, some interventions appear to have relatively persistent effects whereas others do not. The existing literature suggests that intervention features contributing to persistence are not fully understood.

The results of this report can add to the knowledge of longer-term effects of energy interventions and of persistence of changed practices. Knowledge of the persistence of changed habits is particularly critical when trying to meet energy reduction targets (Wemyss et al. 2019) and empirical estimates of the persistence

of behavioral change can make a difference in policymakers program adoption decisions (Allcott &Rogers, 2011). The durability of behavioral change also builds to the understanding of cost-effectiveness and overall impact of an intervention (Burns & Savan, 2018).

The aim of this thesis is twofold. Firstly, I am to examine how the type of data on energy practices of household collected here can be utilized to asses energy intervention introduced change and its persistence. Secondly, I aim to assess the impact of the energy intervention performed here. More particularly I will examine how household practices are changed during the course of an intervention, the persistence of these changes and the factors that contribute to persistence. This thesis approaches the subject through questions:

- How did household practices change when households participated in an intervention?
- How persistent are the observed changes in practices post-intervention?
- What contributes to the persistence of treatment effects?

3 Materials and methods

This thesis takes as its empirical subject the ENERGISE research initiative, a three-year long EU Horizon 2020 funded project run by a consortium of ten research partners from European countries; Bulgaria, Denmark, Finland, Germany, Hungary, Ireland, Slovenia, Switzerland, the Netherlands and the United Kingdom. The ENERGISE initiative was guided by the thought notion of cultural change to be a key component to accomplish energy transitions.

As part of the ENERGISE initiative, 16 living laboratories were implemented in households in eight participating countries. The examination of this thesis is directed on the results of the Finnish living labs, which were produced by the research group of the Center of Consumer Society Research from the University of Helsinki.

The analysis of longer-term effects of the intervention was not in the original aim of the ENERGISE research. I joined the ENERGISE research team for the final stage of the experiment, and have not participated in building the research design, nor have I influenced the data collection methods. My contribution to the project is to look at the longer-term effects from an outsider view and utilize the qualitative and quantitate data the ENERGISE project has produced.

3.1.1 **ENERGISE intervention design**

As mentioned, ENERGISE utilized a living lab approach to research energy cultures. A living lab is a real-life research setting that offers the possibility to gather information from real energy cultures with the ideas of participation and co-creation being central. (Devaney & Davies, 2017; Laakso, Heiskanen, & Matschoss 2017) Bergvall-Kåreborn, Ihlström, Ståhlbröst, and Svensson (2009) define the living lab concept as following:

> "a user-centric innovation milieu built on every-day practice and research, with an approach that facilitates user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values".

Living labs have been initiated by various research organizations due to the ability to produce useful knowledge and to achieve faster social and technical changes (Schliwa et al. 2015).

The intervention strategy used in the participating households was a challenge that targeted two household practices, heating and laundry washing. The two practices were chosen as being directly related to household energy use. Heating as the most energy intensive household practice and laundry as it links to other household practices as drying and ironing. (Laakso et al. 2019)

The personal targets set for the participants were agreed on together with the researcher team. Most of the households agreed on the general targets of reducing indoor temperatures to 18 degrees, and halving their laundry cycles. The intervention included providing the households with heating and laundry challenge kits, containing products, materials and tips to support achieving the set targets. (Heiskanen et al., 2019)

3.1.2 **The set-up: Finnish ELL description**

The two Finnish ENERGISE Living Labs (ELL1 and ELL2) were located in different sites in Finland, to capture the two different Finnish home heating practices. A total of 37 voluntary households started in the study. ELL1 in Porvoo consisted of 19 households and the ELL2 in Merihaka consisted of 18 households. The selection of households was chosen in order to represent the typical Finnish energy related practices, which differ in apartment buildings and single-family homes. The ELL1 located in the town of Porvoo included single family-homes and ELL2 in a high-rise district Merihaka included apartment buildings. The participant's sociodemographic and socioeconomic characteristics strived to present the sociodemographic and socioeconomic composition of the Finnish population as well as possible. (Heiskanen et al. 2019)

3.1.3 **Data**

The living lab experiment was performed over four months from August to November in 2018. Data was collected from participants and from measurement devices. Data consisted of independently filled-in questionnaires, surveys and diary markings, interviews and group discussions.

Questionnaires were sent out during three different time points. The first baseline questionnaire (see APPENDIX 1 for questionnaire) was filled in before the beginning of the four-month experimental period with 39 responses (n39). The second questionnaire, the closing survey (see APPENDIX 2) was filled immediately after the challenge period with a response of 36 answers (n36). The final questionnaire, a follow-up questionnaire (see APPENDIX 3) was administered in March 2019, about three months after the end of the challenges with 34 responses (n34) (see Figure 1). All participating households also filled in weekly surveys and diaries throughout the challenge, but which are not used in this thesis. (Heiskanen et al. 2019)

Interviews and group discussion were conducted both before and after the challenge, each lasting from 1 to 2,5 hours. The group discussion was conducted with ELL1 households from Merihaka and individual interviews were conducted with ELL2 households from Porvoo. After the challenge, closing interviews were conducted in the ELL2 households and a focus group discussion was arranged with the ELL1 households.

Data collection also consisted of monitoring indoor temperatures and laundry-related electricity consumption. The indoor temperatures were monitored with a temperature logger and a power meter was used for quantifying the electricity use of laundry machines and dryers. The impact of the intervention was quantified by the changes in the indoor temperatures and amounts of laundry cycles regarding to the baseline values.

The weekly survey data and logger data / electricity consumption data were compared and these give a relatively similar picture of changes in temperatures and laundry, so the self-reported data is considered relatively reliable. Therefore, the weekly survey / diary data for the baseline and challenge period are used as the primary measure because it is the most comprehensive. (Heiskanen el al. 2019).

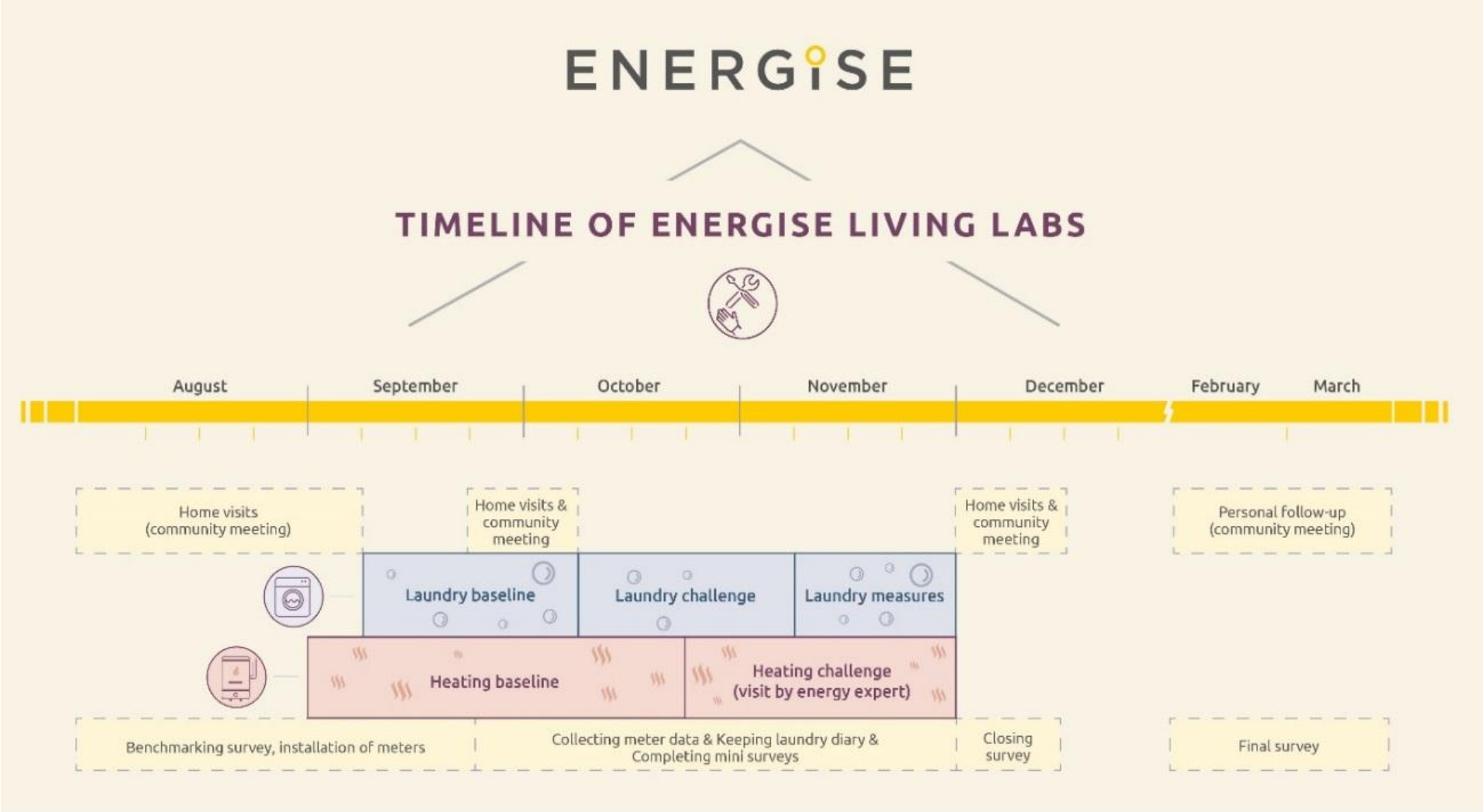

Figure 1 Timeline and data collection for the ENERGISE Living lab intervention, picture from www.energise-project.eu

The analysis of this thesis utilizes the data collected and assesses it in a variety of methods pertaining to the persistence of intervention effects. This thesis emphasizes examination of the participants' self-reported practices in the follow-up survey and explores how the changes in practices persist three months after the intervention. Questions selected for the three-time period comparison presented in the next section, are questions that were presented to participants in each of the three time-points surveys (see APPEDIX1, 2, and 3).

The focus is on the closing interviews conducted by the research team straight after the end of the intervention. The analysis of the interviews examines the formation of new practices in relation to their persistence in everyday life. In addition, answers to open questions that were presented in the follow-up survey form are examined in this thesis to fuller the representation of events.

By triangulation of different research methods, a fuller representation of the researched phenomena is achievable. Employing both qualitative and quantitative methods in social sciences brings a broader range of evidence to understand a phenomenon (Lieber & Weisner, 2010) Different types of research practices complementing each other is also a way to improve the validity of research results. Employing methods that help best answer the research questions is recommended: social science studies often make use of a combination qualitative and quantitative methods. (Flyvbjerg 2006; Alasuutari 2010)

4 Results

The following section presents the results of the comparison of household practices before, right after and three-month post-intervention. In addition, responses to questions that were presented in the follow-up survey are examined, compared, and complemented with observations from the interviews conducted.

The first part of this chapter addresses the responses related to the laundry challenge. The second part presents the responses related to the space heating challenge.

4.1.1 Change and persistence of the practice of keeping clean

At the start of the challenge the number of weekly laundry cycles was an average of 3,7 cycles a week, and straight after intervention the number of laundry cycles to have clearly decreased to 2,6. (Heiskanen et al. 2019) These positive results shown immediately after intervention are in agreement with the majority of the literature that document positive results straight after the end of behavioral interventions (Burns & Savan 2018; Allcot 2011; Komatsu et al. 2015).

The ENERGISE follow-up survey answers interestingly document the number of weekly laundry cycles to have continued to decrease three months after intervention (Figure 2). The decreasing trend from closing to follow-up time-point is quite clear and it can be observed that the number of laundry cycles continued to decline even after the end of the intervention.

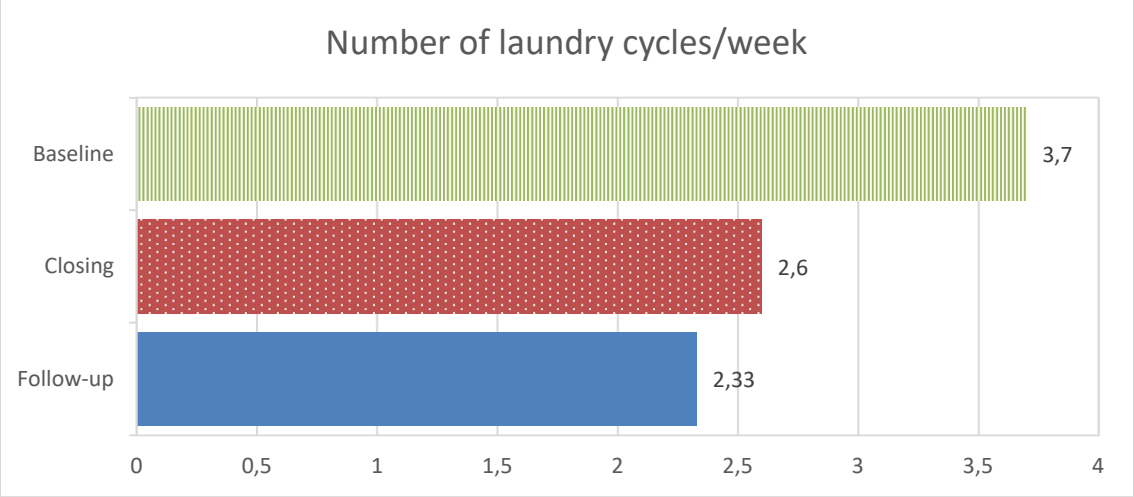

Figure 2 Mean number of laundry cycles at baseline, closing and follow-up.

Interviews show participating in the laundry challenge was considered a positive experience and had produced positive effects in the participant's lives. For example, half of participants in the follow-up survey commented on having saved time due to not doing laundry as much as before, which can assume to support the persistence of the new trend to be still continued three months post-intervention. The laundry challenge was considered easy to implement and the saved time was commented in the follow-up:

Saved time is used to spend time with children more peacefully. Follow-up14

Prior study on persistence of behavioural change also supports the observation, that the intervention techniques of the laundry challenge, committing to a set goal which is supported by a social element to be efficient in producing permanent behavioural change (e.g. Anderson et al 2017; Burns & Savan, 2018) The participants of the ENERGISE challenge committed to self-determined specific goal.

The ENERGISE intervention caused a disruption to participants laundry practices and in the closing interviews right after the intervention, participants reflected on their pre-intervention laundry habits. Participating in the challenge made households question their prevailing habits and the interviews show how the intervention has had influence on the "normal" way of doing laundry:

"It was fun to realize that you really don't need to wash clothes so often, actually. But I used to wash the same favorite things, and now I just used them without washing them" Closing30.

The ENERGISE intervention also functioned in making habits and routines of practices more visible to the participants. Noticing that the changes brought by the intervention were improvements to participants' daily life can also be supportive to the conceived persistence of change.

"It has been more of a habit to put [clothes] always to laundry. Somehow started to be aware that they don't need to be washed after every use. I believe that the new habit will stay… I noticed that one can live with doing less laundry, it was just a habit to put clothes to laundry." Closing26

In addition to observed changes in laundry practices, the questionnaires also aimed to capture underlying changes in how laundry practices are organized. One of these was how participants determined how an item deemed to be in need of laundering: on the basis of the duration of use, or on some more specific criteria

such as smell or stains. It was assumed that once participants became more discriminating in their laundering practices, they would start to consider items more carefully before washing them.

"*Good question, is it necessary to have perfectly clean, just washed clothes? Or would it be enough to have normally clean clothes [without stains]? […] Everything is relative. In the 80's everyone was smoking in their homes, if we would smell like that now, we would be shocked." Deliberation interview30.*

The same question was presented in all three surveys, "what is the most frequent reason to wash a piece of clothing in the household?" (Figure 3). Before the challenge, the length of wear was the most common reason to wash, straight after the intervention is was smell. Three months after the intervention smell was still reported to be the most important reason to wash.

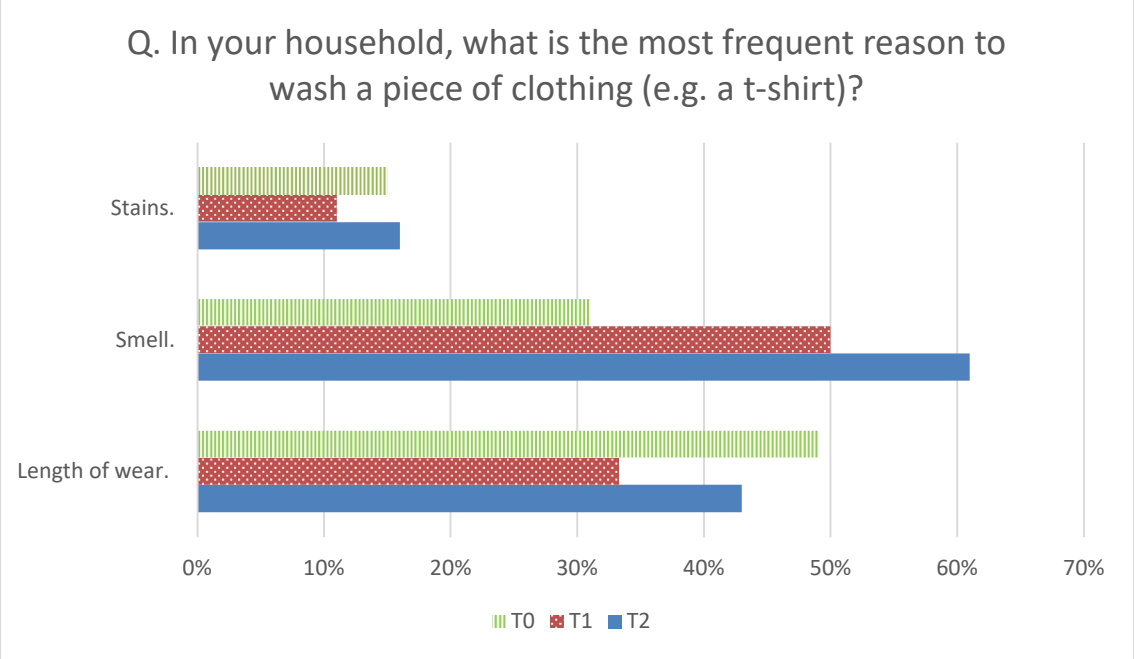

Figure 3 Q. In your household, what is the most frequent reason to wash a piece of clothing (e.g. a t-shirt)? During baseline (T0), closing (T1) and follow-up (T2) time points.

Changes in laundry practices were also expected to depend on the adoption of alternative practices of keeping items clean without washing them. The questionnaires asked about alternative practices before, directly after and three months after the end of the laundry challenge (Figure 4). As can be seen from figure 4,

an increase can be observed in all of the alternative practices of keeping clean, which supports the overall laundry cycle reduction.

Figure 4 Q. What other ways than laundry you keep clothes clean during baseline (T0), closing (T1) and follow-up (T2) time points.

The adoption of alternative practices of keeping clean was also reflected in the he closing interviews.

"Anyways, the amount of laundry dropped a lot. Dropped especially because of my own clothes, I especially ventilated more. I have actually kept the habit now." Closing24.

Four questions in the follow-up survey asked directly how often the household had kept on performing a specific alternative practice of keeping clean three months after intervention, assessed on a six-point Likert scale. A general trend of increasing frequency of reported alternative practice were shown, such as examining clothes carefully to see if they need washing, storing slightly used clothes for reuse, airing clothes to postpone washing them, and removing stains without washing the entire item were mostly reported to be performed "somewhat more frequently" than at the end of the challenge.

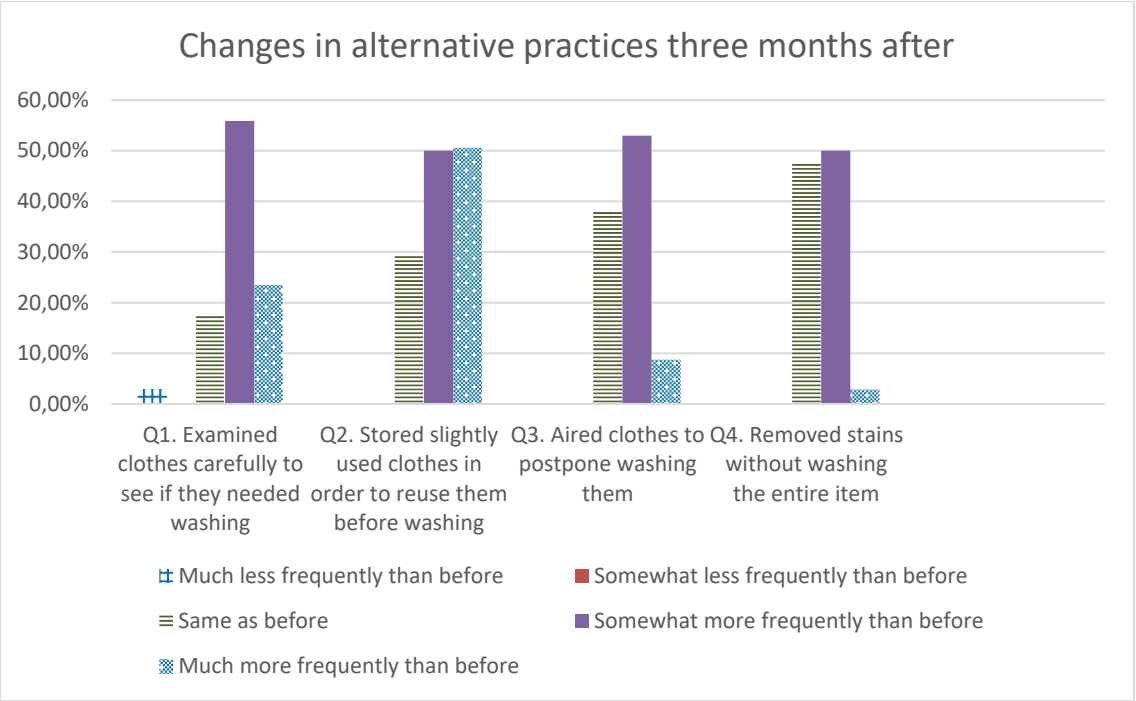

Figure 5 Have you or other members of your household continued to do the following more or less frequently than before? Source: follow-up survey.

The stability of alternative practices can be understood in the light of new routines developed and admitted by participants, as illustrated by the following quote.

"Now that the laundry challenge has ended, and I noticed I've been continuing it without even really thinking about it." Closing39.

4.1.2 **Change and persistence of the practice of keeping warm**

The heating challenge targeted decreasing indoor temperature in the participating households living and bedroom, and possible other (children's) bedroom. The indoor temperature has decreased after the intervention, and lower temperatures were showed to still be in use three months after intervention (Figure 6).

At the start of the challenge, the average indoor temperature in living rooms was 21.7° and right after the challenge indoor temperature has decreased to 20.7°. The same trend showed in the measured bedroom temperatures as well decreasing from 21.2° and 20.8° before intervention, to 20.2° and 20° after intervention. The positive short-term results after intervention can again to be supported by

the majority of the literature, as noted in the previous chapter. The follow-up survey shows indoor temperature to have decreased slightly three months after the end of the intervention.

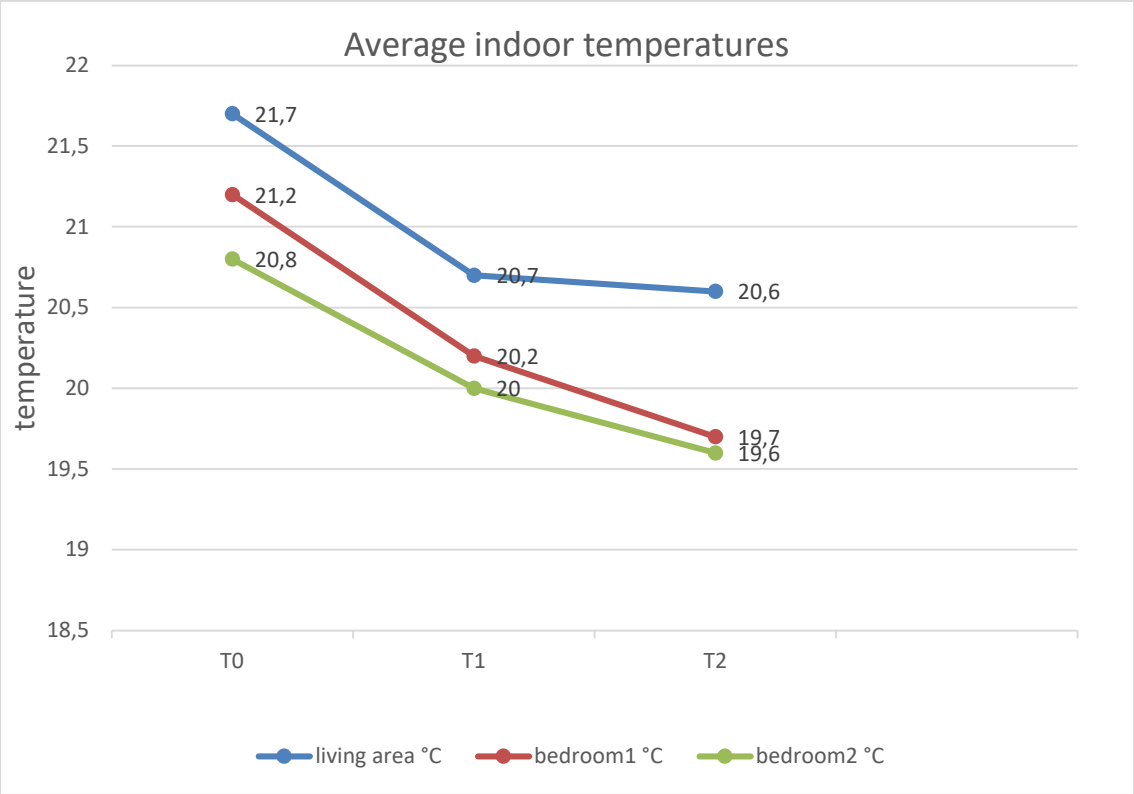

Figure 6 Average indoor temperatures in living are, bedroom1 and bedroom2 during baseline (T0), closing (T1) and follow-up (T2). Source: starting, closing and follow-up surveys.

Indoor temperatures can be seen to relate less to everyday routine than laundry, as indoor temperatures are not adjusted daily. Indoor temperatures are less in need of daily decision making and are result of a one-time decision, with long-range consequences for example lowering heating or turning it off, and not adjusting it back on for the colder season. The preferences of the temperature of the residents are used to is also relevant.

Some difficulties were faced in the heating challenge, especially in the Merihaka households changing indoor temperatures was difficult to achieve due to physical constraints, and even with radiators turned off heat leakage from neighbouring apartments was noticed (Heiskanen et al. 2019). Participants did however find

ways to decrease indoor temperature and found ways to challenge and change heating habits. In the interviews reflection of change of habits was shown:

"Now the difference is that the heat is not on at all in every room." Reflection interview24.

The questionnaires asked the same question at the start, right after and three months after the intervention "what do you consider a good temperature in the living area in winter during daytime?" (Figure 7). As can be seen from figure 7, a slight change can be observed when comparing timepoints.

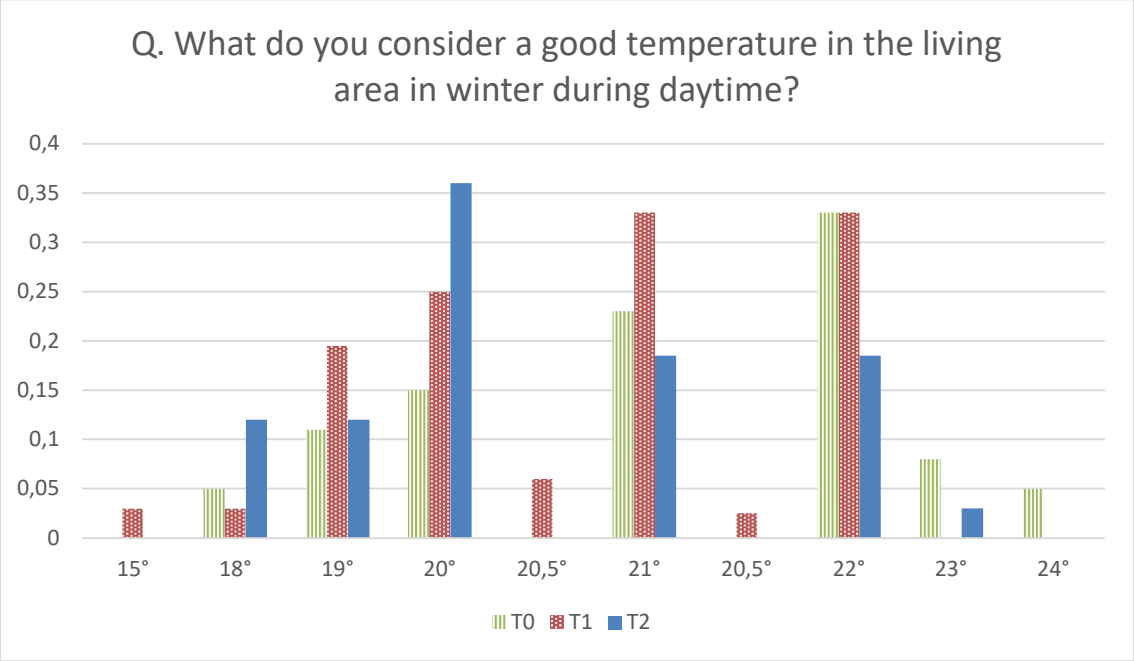

Figure 7 Q What do you consider a good temperature in the living area in winter during daytime? Baseline (T0), closing (T1) and follow-up (T2) time points.

Changes in heating practices were also expected to depend on the adoption of alternative practices of keeping warm, as was in the laundry challenge.
The follow-up survey asked how alternative practices of keeping warm before, directly after, and three months after the end of the heating challenge were implemented by participants (Figure 8). Several of options for the alternative practices in keeping warm, were reported mainly to have not been adopted by the majority of participants during the intervention, as can be observed from Figure 8. Some practices increased during the challenge, for example the alternative

practice of using draught excluders to keep warm and can be observed to have remained in use three month after intervention by part of the respondents.

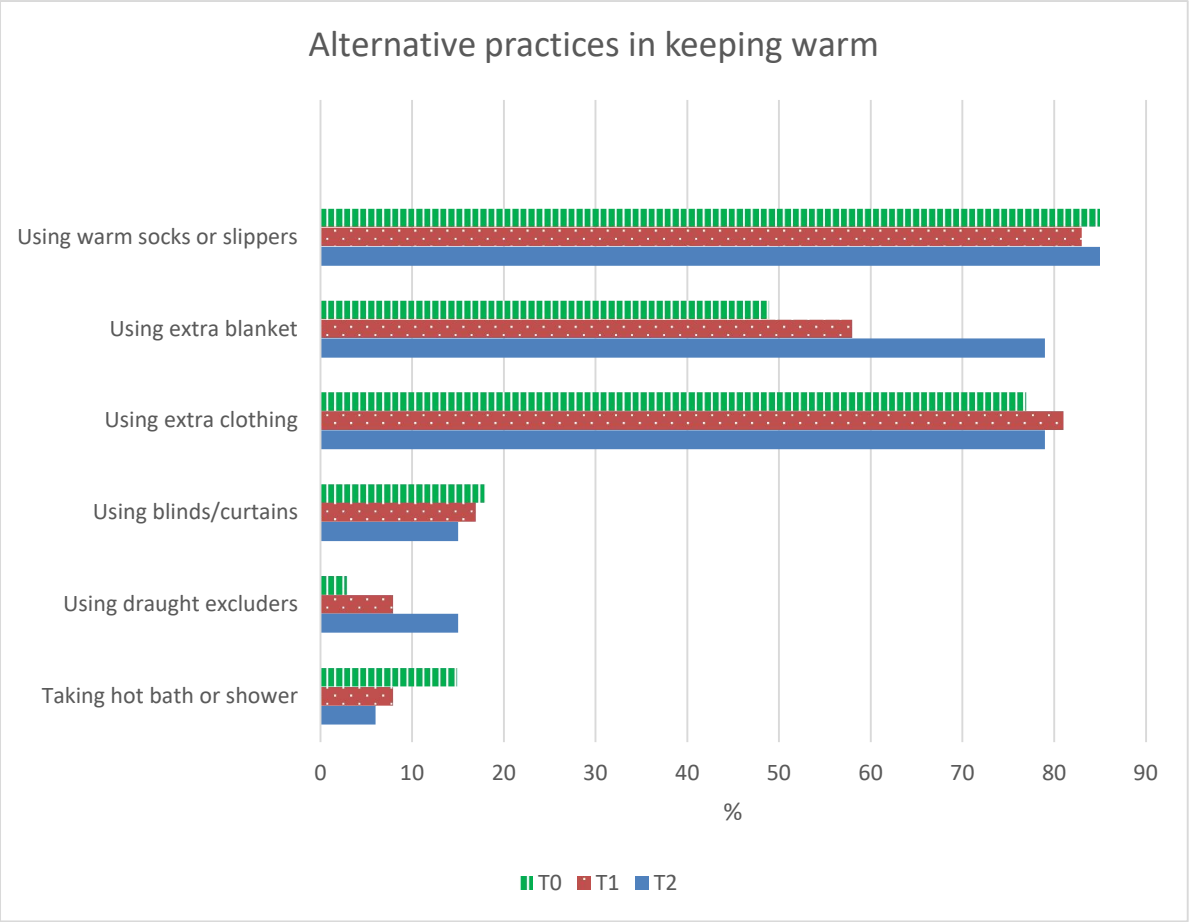

Figure 8 Alternative practices in keeping warm before (T0), closing (T1) and follow-up (T2) time point.

Three questions in the follow-up survey asked directly how often the household had kept on performing a specific alternative practice of keeping warm three months after intervention, assessed on a six-point Likert scale (Figure 9). Only a slight trend of somewhat more frequency of turned down, or turned off heating in certain rooms can be observed in the answers.

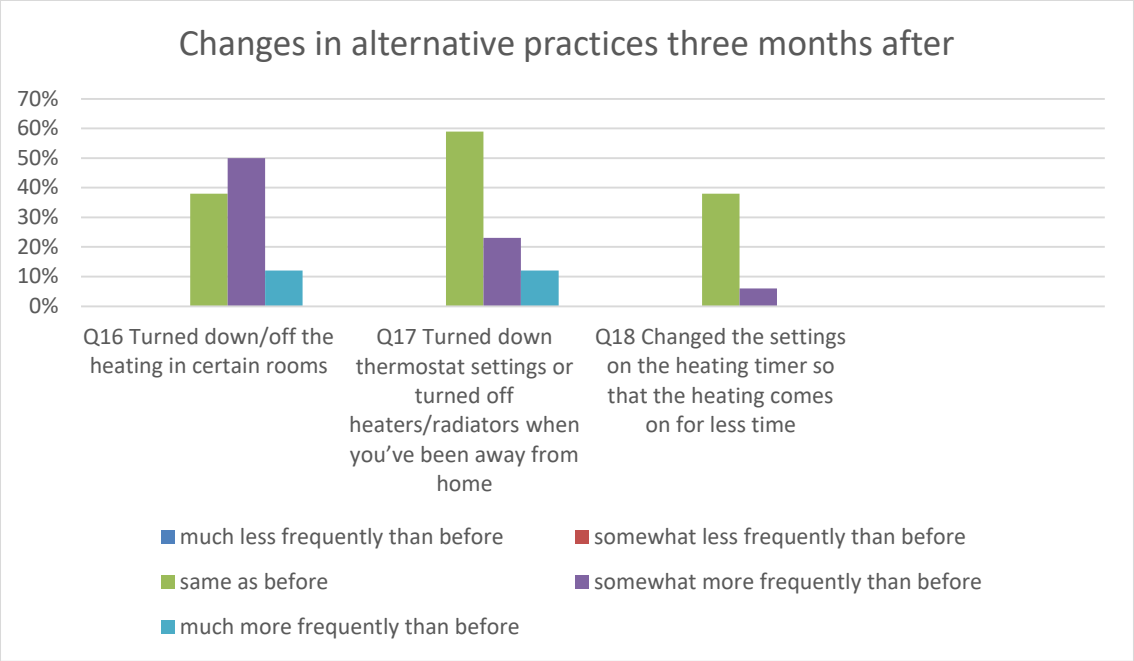

Figure 9 Have you or other members of your household continued to do the following more or less frequently than before? Source: follow-up survey.

5 Discussion

This thesis set out with aim of assessing questions;

- How did household practices change when households participated in an intervention?
- How persistent are the observed changes in practices post-intervention?
- What contributes to the persistence of treatment effects?

The next part of this work will assess the results of this examination and their implications through these questions.

5.1.1 Contribution to understanding persistence of intervention effects

Immediately after the challenges, households had reduced the number of laundry cycles almost one-third and reduced their indoor temperatures about one degree. (Heiskanen et al. 2019) This study found that these changes were persistent three month after the end of the challenge. The results also showed that the number of alternative practices of keeping clean by removing stains or airing clothes at intervention closing, as well as new heating practices adopted, were

still reported three months after intervention. This examination of the ENERGISE intervention results show promises of the intervention to have created persistent behavioral change.

These were very interesting findings, as persistence of behavioral change in a longer-term post intervention examination are not always found (e.g. Allcot & Rogers 2014), especially self-reported long-term post-intervention persistence (Abrahamse et al. 2005) as explained previously. The positive longer-term results of the ENERGISE intervention therefor differed slightly of prior intervention longer-term studies results. There are several possible explanations supporting these encouraging results, but the sample of the research is not enough to make comprehensive statistical generalizations; instead, it gives interesting insight on the durability of the effects of one energy intervention.

In the previous studies investigating longer-term persistence of change, as mentioned in the literature review, findings suggested that the main feature contributing to the persistence of outcomes longer-term, is a carefully thought intervention design. The results of this study support the previous research, as the ENERGISE intervention implemented simultaneously several of the techniques that the reviewed literate pointed. The most efficient intervention techniques that worked best when used simultaneously were noted to be making commitments, goal setting, social comparison elements and providing energy feedback (Burns & Savan 2018; Hargreaves, Nye & Burgess 2013) which were all utilized in the ENERGISE intervention.

Examining household energy consumption through practice theory also requires expanding to how energy consumption is part of several different practices (Gram-Hanssen 2010). For example, the ENERGISE laundry challenge showed how the practice of laundry incorporates sites and spaces beyond the home, as well as the wider social and cultural influence behind household energy use. Participants of the ENERGISE challenges mention points as having to change clothes because wearing the same clothes felt bothering, or having to wash clothes because of requirements of work. The indoor temperature was linked e.g. to keeping small children healthy and with feeling comfortable at home. These

can be seen as some reasons affecting in the background of observable consumption. (Spurling et al. 2013)

The longer-term effects observed of the ENERGISE laundry challenge may have been supported by the risen level of awareness toward behavior. Doing laundry in the contexts of the home, is habitual routine that occurs frequently. (e.g. Devaney and Devaney 2018; Stern 2000). The ENERGISE intervention created a temporary space and a limited time window for the households to reorganize and experiment with this routine, that may usually not be given much thought. The ENERGISE intervention can be seen to have made the routines of heating and laundering visible, providing the participants a possibility to question their usual ways of performing these routines. The challenge offered different ways of performing the routines, which were possibilities to find a new “normal”, for example airing clothes or removing stains instead of tossing clothes straight into the washing machine, or instead of having heating on in every room of the house, to heating only the spaces in use.

The ENERGISE intervention was not aimed to radically transform practices, instead the target was to modify how laundry and heating practices were performed in households and how they linked to other practices as interventions based on practices theory typically strive to do. The self-set goals of decreasing laundry cycles and changing indoor temperature requested quite small-scale deeds and subtle shifts from the participants. Both the heating and laundry challenges can be seen as deeds that required changes from performing to not performing, which may be factors supporting the persistence of practices to still persist in the follow-up examination.

This corroborates with findings and views of pervious works e.g. Warde (2005) claims that achieving sustainable actions is not to be seen as a decision to preform “the right” choice and Anderson et al. (2017) remind that changing people’s attitudes is not obligatory. Instead, the actions that are embedded within and occurring as parts of the targeted practices should be understood and then approached by intervention, and when participants benefit from the new ways of doing and the new routines are found to function well, will support to settle into

everyday life after intervention ending. The closing and follow-up surveys open responses also reported some participants to have had implemented changes in other areas in their life as well, behavior interventions have found to have affected practices beyond targeted behaviors (Burns & Savan 2018). Overall, the interviews showed generally the positive impressions of the challenge dominate the negative ones.

Other possible explanations can also be viewed, when assessing these results. The actual focus in the intervention was not on energy use or money saving was not a priority, or specially underlined in the ENERGISE intervention. Money as a motivator for change has proven to be of little consequence to change individual's behavior (Bator et al 2019) and based on this examination, the absence of financial benefits did not have consequence even in the longer-term observations.

The timing of the ENERGISE intervention reflecting on the results of persistence should also be viewed, as the intervention started from fall and ended in spring. Allcot and Rogers (2014) found intervention effects to be highly seasonal. Summertime was mentioned to be a season of more laundry in some ENERGISE households as well as households with kids mentioning muddy seasons to have an effect on the number of laundry cycles per week. (Heiskanen et al, 2019) It seems possible that the timing of the intervention supported the new habits to persist. It would be interesting to assess the persistence of adopted change in the participating households for example one year after the intervention end.

Another possible explanation contributing to these results, could be the research setting and the relationship created between the research group and the participants. In addition to the voluntary nature of the participation, the process, and the place-based living labs may contribute to strong commitment to the challenges and have supported to the persistence in the longer-term results. The participants were visited and interviewed in their own homes several times, which can see to have provided social support to encourage toward maintaining the new behavior. The possibility to share their views, experiences, ideas and concerns could have influenced to make them committed to the project.

This thesis results expands the research of previous authors and suggests that interventions should understand what is happening in the household in order to understand and produce effective interventions with longer-term effects. A wider review of unsuccessful energy interventions with examination on intervention design would be very interesting, and contribute to the understanding of why permanent behavioral change has not been achieved.

The approach of the social practice theory is strengthened by the observations of this thesis. As intervention designs usually already combine multiple treatments, a question for further study is which individual treatments are effective in creating behavioral persistence longer-term?

5.1.2 Limitations of the research design and material

Some hesitations towards the results must be taken. The findings of this thesis are subjected to some limitations.

The discussion presented from the observations are conclusions formed from a detailed examination of one intervention case. While the findings of this examination are very promising, the size of the scope and the possibilities to generalize and contribute to scientific development with knowledge from only one case is limited. The examined interventions time span from the end of the intervention to the follow-up survey was relatively short. A longer follow-up time span could have offered a broader view to the discussion of the observed persistence of behavioral change.

6 Conclusions

The purpose of this thesis is to join in on the current climate change debate by adding to the knowledge of creating persistent change in household energy practices. Households consume a large amount of final energy, giving them a central position in decreasing energy consumption. Achieving changes in energy related

practices of households would contribute significantly in decreasing overall energy use, thus making households a sensible target for behavior change interventions. Behavioral interventions have been gaining popularity in the academic field and behavior change can be seen as one cornerstone in transiting to more sustainable energy cultures. The possibilities of behavioral interventions to be implemented with only low upfront investments and chances to gain knowledge from real life settings are some of the reasons that have contributed to this development. Small-scale household-based interventions can provide important local samples which can be used to guide new energy policy possibilities.

In a strive to construct a holistic view, this thesis first sets out to determine previous research conducted on longer-term effects of energy interventions. Generally, it can be stated that longer-term effects of interventions are not systematically investigated, and when researched, evidence on the persistence of behavioral changes is scarce.

Then this thesis continues to introduce the practice theory as an approach to view energy consumption. Central in the practice theory approach, is the theory's grip, which focuses on the organization of everyday life. Understanding the social interactions and power relations in the performance of practices, helps to build understanding on the issues behind energy consumption that should be focused, on to create change. The view is set on what are holding everyday practices together and how they are interlinked, rather than focusing on energy use itself.

The questions posed at the beginning of this study to guide this work aimed to investigate the possible changes in targeted household practices and the persistence of new behavior after the discontinuation of the intervention. A wider question sought to investigate what contributes to the persistence of treatment effects. The empirical data examined introduced in this thesis is from a currently implemented small-scale behavioral change energy intervention. The intervention viewed was built on recognizing the importance of socio-cultural and material contexts of everyday life on order to achieve sustainable energy consumption.

This thesis continued from there, focusing on longer-term effects post intervention. Examination of the longer-term results of the intervention were encouraging, as persistence of behavioral change can be said to have been observed in the follow-up survey answers three months post-intervention. This examination suggests the issues contributing to the persistence of changed behavior, this examination suggests were the questioning of households existing routines and conventions and adopting alternative practices. Support for these results can have be provided by the easy changes required, rather more of the giving up of doing something as well as the social support provided by the research team. The findings of persistence of change differed some from what has usually been reported in longer-term intervention reviews and can provide new understanding in creating permanent change.

Taken together, even though the results are based on a small and non-representative sample and a short time frame, the results of this examination suggest that an intervention designed on practice theory can offer important support in creating persistent behavioral change. A broader perspective of energy related practices, which takes in account more aspects than the conventional behavioral interventions have, can play a key role when aiming to replace already existing practices in households. Examining how energy related practices link or how they are in conflict with other practices, is a way to capture the range of sectors effecting behaviors when analyzing behavioral change aiming interventions.

An intervention design should also incorporate elements that support maintenance of new behaviors, for example embedded motivational elements that are in the real-life social context of the participants. (Breukers & Mourik 2013) Understanding how everyday reality is different for every individual should also be taken into account in intervention planning. The participants that entered the ENERGISE challenge had diverging practices, expectations and habits, which contributes to achievable results. Interventions that target whole populations, cannot consider difference of all individuals.

Although settling outside the primary aim of the examined ENERGISE intervention, the cost-effectiveness of an intervention should also be assessed, to bring more insight of the overall effectiveness of the program. The duration time of the rollout showed in previous research to be a key component on achieving persistence of change, however every intervention program loses its cost-effectiveness if it has to be continued for an indefinable time or re-employed several times. (Burns and Savan, 2018)

Changes in socio-economic status have also shown to have an impact on energy conservation (Brounen, Kok, Quigley 2012), previous research has shown e.g. that family income plays a key role in household electricity consumption. This should also be noted when designing the duration period of interventions and possible follow-up research to maintain the opportunity to compare starting and follow-up situations.

The energy intensive everyday life of the western world, the increasing global population and insatiable desire for material good are some strong forces of today's global environmental problems. (Swim et al., 2011) Energy is strongly linked with the social and economic development around the world, many factors influence the daily decisions and actions relating to energy use. Sustainable energy behavior, a central component in the transition to more sustainable energy systems, is a result of a collection contributions. And rather than the capacity of an individual to carry out change, as Shove (2003) states, the need for a structural change in society is also to be seen as a part of this transition.

In the strive to change existing energy consumption practices and create new energy cultures in the need to meet the needed energy-saving goals and needs of the future, more research work in needed in several fields. Designing interventions that create permanent behavioral change benefits from support from a wide range of disciplines, from energy technology that helps create less electricity using environments to higher public awareness of energy consumptions social and environmental impacts. Future studies on this subject must be conducted to gain more understanding.

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Appendices

APPENDIX 1

ENERGISE LIVING LAB BASELINE SURVEY

The aim of the ENERGISE baseline questionnaire is to gain an overview of your household's energy routines and viewpoints before the start of the ENERGISE Living Lab. Thank you for your responses!

1 / 32 Who looks after the temperature settings in your home, most of the time?

- ☐ Male adult
- ☐ Female adult
- ☐ Other

2 / 32 Can you adjust thermal settings by room or for your entire home?

- ☐ By room only
- ☐ For the entire home only
- ☐ Both

3 / 32 In the winter, do you sometimes turn down the heating? (several answers possible)

- ☐ No
- ☐ Yes, for the night.
- ☐ Yes, when not at home.
- ☐ Yes, in unused or less used rooms.
- ☐ Yes, the system is programmed to automatically turn down the heating at certain times.
- ☐ Yes, other:

4 / 32 In the winter, do you air out rooms?

- ☐ No.
- ☐ Yes, once a day for a few minutes.
- ☐ Yes, once a day for at least one hour.
- ☐ Yes, all day.
- ☐ Yes, all night.
- ☐ Yes, other:

5 / 32 When you air out rooms, do you turn down the heating?

- ☐ Yes
- ☐ No
- ☐ Not applicable as I do not air out rooms.

2 6 / 32 How do you keep warm in the colder months, in addition to changing the heat settings? (several answers possible)

- ☐ I do nothing additional.
- ☐ I use warm socks/slippers.
- ☐ I use an extra blanket.
- ☐ I use extra clothing (sweater, cardigan, etc.).
- ☐ I use blinds/curtains on windows.
- ☐ I use draught excluders.
- ☐ I take a hot bath or shower.
- ☐ Other.

7 / 32 In the winter, is the usual daytime temperature in your home too low, too high or just right for you?

- ☐ Low.
- ☐ High.
- ☐ Just right.

8 / 32 What about in your bedroom?

- ☐ Low.
- ☐ High.
- ☐ Just right.

9 / 32 What about in a shared living area?

- ☐ Low.
- ☐ High.
- ☐ Just right.

10 / 32 Would other household members agree with you?

- ☐ Yes
- ☐ No.

11 / 32 What do you consider a good temperature in the living area in winter during daytime?

12 / 32 What do you consider a good temperature in your bedroom in winter during daytime?

13 / 32 What do you consider a good temperature in a child's bedroom in winter during daytime?

14 / 32 Who generally takes care of laundry in your household?

- ☐ Male adult.
- ☐ Female adult.
- ☐ Other.

15 / 32 What is the energy efficiency rating of your washing machine?

- ☐ A++
- ☐ A+
- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ I don't know.

16 / 32 In your household, what is the most frequent reason to wash a piece of clothing (e.g. a t-shirt)?

- ☐ I don't know.
- ☐ Stains.
- ☐ Smell.
- ☐ Length of wear.
- ☐ Other.

17 / 32 In what ways do you keep clothes clean, apart from washing them in the washing machine? (several answers possible)

- ☐ No other ways.
- ☐ Wash out stains by hand.
- ☐ Brush out stains.
- ☐ Air out clothes.
- ☐ Prevent stains (e.g. by wearing an apron).
- ☐ Other.

18 / 32 How many laundry cycles are washed in your household on average per week?

19 / 32 How often does your household wash cold (30°C or lower)?

- ☐ Regularly.
- ☐ Sometimes.
- ☐ Rarely.
- ☐ Never.

20 / 32 At what temperature does your household usually wash white/light clothes?

21 / 32 At what temperature does your household usually wash darks?

22 / 32 At what temperature does your household usually wash bed linen, towels, etc.?

23 / 32 Do you hand-wash items? (several answers possible)

- ☐ No.

- ☐ Yes, to remove stains.
- ☐ Yes, to wash delicate items.
- ☐ Yes, other.

24 / 32 How often does your household use a dryer/drying cabinet?

- ☐ For almost every laundry load.
- ☐ For about half of all laundry loads.
- ☐ For less than half of all loads.
- ☐ Rarely.
- ☐ Never, I don’t own or have access to a dryer/drying cabinet.
- ☐ Never, because:

25 / 32 How much laundry is ironed in your household?

- ☐ Almost everything.
- ☐ About half of all laundry.
- ☐ Less than half of all laundry.
- ☐ Hardly anything.
- ☐ Nothing

26 / 32 Is there an energy efficiency setting or programme on your washing machine?

- ☐ Yes.
- ☐ No.
- ☐ I don't know.

27 / 32 If yes, how regularly do you use it?

- ☐ Almost always.
- ☐ Sometimes.
- ☐ Rarely.
- ☐ Never.

28 / 32 In the past 10 years, have any of the following investments been made in the house where you live? (several answers possible)

- ☐ Energy efficient heating system/boiler.
- ☐ Insulation.
- ☐ Draught-proofing.
- ☐ Renewable energy (e.g. solar panels).
- ☐ Heat pump.
- ☐ Programmable thermostats or smart technologies to control the heating system.
- ☐ Other energy-related investments.
- ☐ I don't know.
- ☐ No, because...

29 / 32 Do you engage with energy and climate issues? (several answers possible)

- ☐ Not specifically.
- ☐ Yes, I raise energy and climate issues at home or with friends.

- ☐ Yes, I raise energy and climate issues at work.
- ☐ Yes, I raise energy and climate issues in NGOs or other groups of which I am a member.
- ☐ Yes, I actively search for news or information on energy and climate issues.
- ☐ Yes, I consider energy and climate issues when voting.
- ☐ Yes, I consider energy efficiency when buying electrical appliances/devices.
- ☐ Yes, I....

30 / 32 Of the following list, please select what applies to you: (several answers possible)

- ☐ I turn off electrical appliances/devices when not in use (no stand-by).
- ☐ I buy energy efficient appliances (e.g. fridge, washing machine).
- ☐ I buy energy efficient user electronics (e.g. TV, computer).
- ☐ I buy energy efficient light bulbs.
- ☐ I take short showers (5-6 minutes).
- ☐ Other…

31 / 32 Do you know the approximate amount of energy (in kWh) your household consumes per year?

- ☐ No.
- ☐ No, but I know where to check.
- ☐ Yes:

32 / 32 Do you know how much your household pays for energy per month?

- ☐ No.
- ☐ No, but I know where to check.
- ☐ Yes.

APPENDIX 2

ENERGISE LIVING LAB CLOSING SURVEY

Many thanks for participating in the ENERGISE challenges! The challenges have now ended and we would like to learn how you and your household experienced them and how you think the experience might influence what you will do in the future. Please answer the following questions. We look forward to hearing more details when meeting you in person.

1 / 45 Since the start of the ENERGISE challenge, what is the most frequent reason to wash a piece of clothing in your household (e.g. a t-shirt)?

- ☐ I don't know
- ☐ Stains
- ☐ Smell
- ☐ Length of wear
- ☐ Other

2 / 45 Since the start of the ENERGISE challenge, in what ways do you keep clothes clean, apart from washing them in the washing machine? (several answers possible)

- ☐ No other ways
- ☐ Wash out stains by hand
- ☐ Brush out stains
- ☐ Air out clothes
- ☐ Prevent stains (e.g. by wearing an apron)
- ☐ Other

3 / 45 Since the start of the ENERGISE challenge, how many laundry cycles are washed in your household on average per week?

4 / 45 Since the start of the ENERGISE challenge, how often does your household wash cold (30°C or lower)?

- ☐ Regularly
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Have you or other members of your household done the following more or less frequently than before as a direct result of participating in the laundry challenge?

5 / 45 Examined clothes carefully to see if they needed washing

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

6 / 45 Stored slightly used clothes in order to reuse them before washing

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

7 / 45 Aired clothes to postpone washing them

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

8 / 45 Removed stains without washing the entire item

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

9 / 45 Washed at colder temperatures

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

10 / 45 Washed fuller loads

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

11 / 45 Used an eco programme on the washing machine (if there is one)

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before
- ☐ Not applicable

12 / 45 Used the dryer (if you have one)

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before
- ☐ Not applicable

13 / 45 Ironed clothing or other items (if you have an iron)

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before
- ☐ Not applicable

14 / 45 Purchased clothing, bed linen, towels, etc. to be able to go without laundering for longer

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before
- ☐ Not applicable

15 / 45 If you or other household members have made any other changes as a direct result of participating in the ENERGISE laundry challenge, please take a moment to list or describe these changes here:

16 / 45 Since the start of the ENERGISE challenge, do you sometimes turn down the heating? (several answers possible)

- ☐ No
- ☐ Yes, for the night
- ☐ Yes, when not at home
- ☐ Yes, in unused or less used rooms
- ☐ Yes, the system is programmed to automatically turn down the heating at certain times
- ☐ Yes, other

- ☐ Not applicable as the heating system has not been turned on yet

17 / 45 Since the start of the ENERGISE challenge, do you turn down the heating when you air out rooms?

- ☐ Yes
- ☐ No
- ☐ Not applicable, as I do not air out rooms

18 / 45 Since the start of the ENERGISE challenge, how do you keep warm, in addition to changing the heat settings? (several answers possible)

- ☐ I do nothing additional
- ☐ I use warm socks/slippers
- ☐ I use an extra blanket
- ☐ I use extra clothing (sweater, cardigan, etc.)
- ☐ I use blinds/curtains on windows
- ☐ I use draught excluders
- ☐ I take a hot bath or shower
- ☐ Other

19 / 45 What do you now consider a good temperature in the living area in winter during daytime?

20 / 45 What do you now consider a good temperature in your bedroom in winter during daytime?

21 / 45 What do you now consider a good temperature in a child's room in winter during daytime? Have you or other members of your household done more or less of the following as a direct result of participating in the heating challenge?

22 / 45 Turned down the heating in certain rooms

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

23 / 45 Turned down thermostat settings or turned off heaters/radiators when you've been away from home

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

- ☐ Not applicable

24 / 45 Changed the settings on the heating timer so that the heating comes on for less time

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before
- ☐ Not applicable

25 / 45 Worn extra clothing to keep warm

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

26 / 45 Worn socks or slippers to keep warm

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

27 / 45 Used a blanket to keep warm when sitting on the sofa etc.

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

28 / 45 Used extra blankets to keep warm during the night

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

29 / 45 Had warm foods or drinks to keep warm

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

30 / 45 Moved around in order to keep warm

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

31 / 45 Spent more time with family/friends in a single room

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

32 / 45 If you or other household members have made any other changes as a direct result of participating in the ENERGISE heating challenge, please take a moment to list or describe these changes here:

33 / 45 Has participating in the project resulted in you and others doing more housework or less housework?

- ☐ Much less than before
- ☐ Somewhat less than before
- ☐ Same as before
- ☐ Somewhat more than before
- ☐ Much more than before

Do you feel the project has created more housework or less housework work for each of the following household members?

34 / 45 The female adult in your family (if there is one)

- ☐ Much less than before
- ☐ Somewhat less than before
- ☐ Same as before
- ☐ Somewhat more than before
- ☐ Much more than before
- ☐ Not applicable

35 / 45 The male adult in your family (if there is one)

- ☐ Much less than before
- ☐ Somewhat less than before
- ☐ Same as before
- ☐ Somewhat more than before

- ☐ Much more than before
- ☐ Not applicable

36 / 45 One or more children aged 15 or older (if there is one)

- ☐ Much less than before
- ☐ Somewhat less than before
- ☐ Same as before
- ☐ Somewhat more than before
- ☐ Much more than before
- ☐ Not applicable

37 / 45 One or more children aged below 15 (if there is one)

- ☐ Much less than before
- ☐ Somewhat less than before
- ☐ Same as before
- ☐ Somewhat more than before
- ☐ Much more than before
- ☐ Not applicable

Select 38 / 45 Since the start of the challenge, have you engaged with energy and climate issues beyond your participation in ENERGISE? (several options possible)

- ☐ Not specifically
- ☐ Yes, I raised energy and climate issues at home or with friends
- ☐ Yes, I raised energy and climate issues at work
- ☐ Yes, I raised energy and climate issues in NGOs or other groups of which I am a member
- ☐ Yes, I actively searched for news or information on energy and climate issues ♦ Yes, I considered energy and climate when voting
- ☐ Yes, I considered energy efficiency when buying appliances
- ☐ Yes, other

39 / 45 Have you discussed your ENERGISE challenge or the activities you did as a result of the challenge with anyone outside your household (in person, or over social media)?

- ☐ Yes, a lot
- ☐ Yes, a few times
- ☐ No

40 / 45 Did the exchange of experiences or ideas with people outside your household provide you any of the following benefits? (several answers possible) ♦ Encouragement

- ☐ Practical tips and advice
- ☐ Enjoyable interaction
- ☐ Interesting general information
- ☐ None of the above
- ☐ Other

41 / 45 Did the exchange of experiences or ideas with people outside your household entail any of the following negative effects? (several answers possible)

- ☐ Confusion
- ☐ Discouragement
- ☐ Annoyance
- ☐ Frustration
- ☐ None of the above
- ☐ Other

42 / 45 What challenge did you select for laundry, before starting the challenge?

- ☐ The common ENERGISE challenge -- (cutting laundering in half)
- ☐ A personal challenge

43 / 45 Do you feel you managed to achieve your laundry challenge?

- ☐ Yes, completely
- ☐ Yes, somewhat
- ☐ Not really
- ☐ Not at all

44 / 45 What challenge did you select for heating, before starting the challenge?

- ☐ The common ENERGISE challenge -- (reducing temperature to 18°C)
- ☐ A personal challenge

45 / 45 Do you feel you managed to achieve your heating challenge?

- ☐ Yes, completely
- ☐ Yes, somewhat
- ☐ Not really
- ☐ Not at all

APPENDIX 3

ENERGISE Follow-up questionnaire

Some time has passed since experimenting with new household practices related to heating and laundry in the ENERGISE Living Lab. Now, the research team is eager to learn about what has changed and also welcomes comments and reflections!

Have you or other members of your household continued to do the following more or less frequently than before:

1 / 52 Examined clothes carefully to see if they needed washing

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

2 / 52 Stored slightly used clothes in order to reuse them before washing

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

3 / 52 Aired clothes to postpone washing them

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

4 / 52 Removed stains without washing the entire item

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

5 / 52 Washed at colder temperatures

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before

- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

6 / 52 Washed fuller loads

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

7 / 52 Used the eco programme on the washing machine (if there is one)

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

8 / 52 Used the dryer (if you have one)

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

9 / 52 Ironed clothing or other items

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

10 / 5 2Other changes (laundry)

If you continued doing any other changes that you started during the ENERGISE Living Lab challenges, please tell us about them here:

11 / 52 How often does your household now wash cold (30°C or lower)?

- ☐ Regularly
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

12 / 52 How many laundry cycles are now washed in your household on average per week (based on your memory)?

13 / 52 In what ways do you now keep clothes clean, apart from washing them in the washing machine? (several answers possible)

- ☐ No other ways
- ☐ Wash out stains by hand
- ☐ Brush out stains
- ☐ Air out clothes
- ☐ Prevent stains (e.g. by wearing an apron)
- ☐ Other

14 / 52 What is now the most frequent reason to wash a piece of clothing in your household (e.g. a t-shirt)?

- ☐ I don't know
- ☐ Stains
- ☐ Smell
- ☐ Length of wear
- ☐ Other

15 / 52 During the challenge, did you feel more comfortable or less comfortable when wearing your clothes in public?

- ☐ More comfortable
- ☐ Less comfortable
- ☐ Neither more nor less comfortable

Have you or other members of your household continued to do more or less of the following:

16 / 52

- ☐ Turned down/off the heating in certain rooms
- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

17 / 52 Turned down thermostat settings or turned off heaters/radiators when you've been away from home

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)

- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

18 / 52 Changed the settings on the heating timer so that the heating comes on for less time

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

19 / 52 Worn extra clothing to keep warm

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

20 / 52 Worn socks or slippers to keep warm

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

21 / 52 Used a blanket to keep warm during the day, e.g. when sitting on the sofa

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

22 / 52 Used an extra blanket to keep warm during the night

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

23 / 52 Had warm foods or drinks to keep warm

- ☐ Much less frequently than before

- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

24 / 52 Moved around more in order to keep warm

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

25 / 52 Spent more time with family/friends in the same room

- ☐ Much less frequently than before
- ☐ Somewhat less frequently than before
- ☐ Same as before (irrespective of whether this was rarely or often)
- ☐ Somewhat more frequently than before
- ☐ Much more frequently than before

26 / 52 Other changes (heating)

If you continued doing any other changes that you started during the ENERGISE Living Lab challenges, please tell us about them here:

27 / 52 Please estimate your average living room temperature in the evening (between 6 to 8 pm).
°C

28 / 52 Please estimate your average bedroom temperature in the evening (between 6 to 8 pm).
°C

29 / 52 If relevant, please estimate your average child(ren)'s room temperature in the evening (between 6 to 8 pm).
°C

30 / 52 Do you now sometimes turn down/off the heating? (several answers possible)

- ☐ No
- ☐ Yes, for the night
- ☐ Yes, when not at home
- ☐ Yes, in unused or less used rooms
- ☐ Yes, the system is programmed to automatically turn down the heating at certain times
- ☐ Yes, other

31 / 52 Since our last interview, how do you now keep warm apart from changing the heat settings? (several answers possible)

- ☐ I do nothing additional
- ☐ I use warm socks/slippers
- ☐ I use an extra blanket
- ☐ I use extra clothing (sweater, cardigan, etc.)
- ☐ I use blinds/curtains on windows
- ☐ I use draught excluders
- ☐ I take a hot bath or shower
- ☐ Other

32 / 52 What do you now consider a good temperature in the living area in winter during daytime?
°C

33 / 52 What do you now consider a good temperature in your bedroom in winter during daytime?
°C

34 / 52 During the challenge, did you change the temperature when having guests at home?

- ☐ Yes
- ☐ No
- ☐ I/we had no guests

How often are you (or another person) at home in the daytime from Monday to Friday?

- ☐ Always
- ☐ Often
- ☐ Rarely
- ☐ Never

36 / 52 Are weekdays in your household similar to each other in terms of who is at home and what they do? (If kids live with you every other week, consider similar weeks)

- ☐ Always
- ☐ Often
- ☐ Rarely
- ☐ Never

37 / 52 To what extent is your daily life (chores like shopping, cooking, cleaning) organised (planned) vs. improvised (unplanned, ad hoc)

- ☐ Very well organised
- ☐ More organised than improvised
- ☐ As much improvised as organised
- ☐ More improvised than organised
- ☐ Improvised the most part of the time

38 / 52 Do you like to experiment with new ways of doing things in your daily life?

- ☐ Absolutely
- ☐ Often
- ☐ Rarely
- ☐ Never
- ☐ Select

39 / 52 Do you now engage with other energy and climate issues? (several answers possible)

- ☐ Not specifically
- ☐ Yes, I raise energy and climate issues at home or with friends
- ☐ Yes, I raise energy and climate issues at work
- ☐ Yes, I raise energy and climate issues in NGOs or other groups of which I am a member
- ☐ Yes, I actively search for news or information on energy and climate issues
- ☐ Yes, I consider energy and climate when voting
- ☐ Yes, I consider energy efficiency when buying appliances
- ☐ Yes, I buy energy efficient light bulbs
- ☐ Yes, I take shorter showers (5-6 minutes)
- ☐ Yes, other

40 / 52 Since having finished the challenges, have you spoken about the ENERGISE project with family, friends, neighbours or colleagues during the past 3 months? (several answers possible)

- ☐ Not specifically
- ☐ Other members of my household
- ☐ Extended family / relatives
- ☐ Friends
- ☐ Neighbours
- ☐ Co-workers
- ☐ Groups/associations in which I participate
- ☐ With people at my child(ren)'s kindergarten, school, sports club or similar
- ☐ Other

41 / 52 Have you shared your experiences in the ENERGISE challenges in the following media? (several answers possible)

- ☐ Not specifically
- ☐ Facebook, Twitter or Instagram
- ☐ Blog post
- ☐ Newspaper article
- ☐ Other
- ☐ Select

42 / 52 Do you think your household has saved money over the past six months as a result of participating in the ENERGISE project?

- ☐ Not specifically
- ☐ Yes, about 5-20€
- ☐ Yes, about 20-50€
- ☐ Yes, about 50-100€
- ☐ Yes, more than 100€
- ☐ I don’t know

43 / 52 If you have saved money, what have you used it for or what will you use it for? (several answers possible)

- ☐ Not applicable, no money saved
- ☐ Every day running costs
- ☐ Savings
- ☐ Eating out
- ☐ Purchase of new equipment
- ☐ Entertainment
- ☐ Travel
- ☐ I don't know yet
- ☐ Other

44 / 52 If you already have very specific plans with the money saved (e.g. the travel destination or type of equipment you are going to buy), please mention this here:

45 / 52 Do you think your household has saved time as a result of participating in the ENERGISE project?

- ☐ No
- ☐ Yes, less than 1 hour a week
- ☐ Yes, 1-2 hours a week
- ☐ Yes, 3-4 hours a week
- ☐ Yes, more than 4 hours a week
- ☐ I don’t know

46 / 52 If you have saved time, what have you used it for? (several answers possible)

- ☐ Not applicable, no time saved
- ☐ Sleeping
- ☐ Reading
- ☐ TV / computer
- ☐ Cooking
- ☐ Other housework
- ☐ Home maintenance
- ☐ Sports or outdoors
- ☐ Cultural activities
- ☐ Social activities

- ☐ Working
- ☐ Travel
- ☐ I don’t know
- ☐ Other

47 / 52 Do you think your household has saved any energy as a result of participating in the ENERGISE project?

- ☐ No
- ☐ Less than 5% of our annual energy use
- ☐ 5-10% of our annual energy use
- ☐ 10-20% of our annual energy use
- ☐ More than 20% of our annual energy use
- ☐ I don’t know

48 / 52 Has participating in the ENERGISE challenges changed the way you monitor or pay attention to your energy consumption?

- ☐ No
- ☐ Yes

49 / 52 Please elaborate on the changes in how you are monitoring your energy use - or explain why nothing has changed in this regard:

50 / 52 Are there other things in your everyday life that you do differently as a result of participating in the ENERGISE challenges?

- ☐ No
- ☐ Yes

51 / 52 What would increase your engagement and motivation to reduce laundry and/or heating, or change your level of consumption in other areas?

52 / 52 Do you have any other feedback on the project?